seen, as compared with the dimming off of those parts of the solar atmosphere which are farther removed.

Now, can we watch this? Can we study it so that we can find out all about it? Well, not entirely. The photosphere which carries the spots to which I have referred allows us certainly to see the phenomena of the spots, but then it acts as a veil that prevents us seeing anything nearer the centre of the sun, whatever it is. It practically serves as a veil for all the underlying phenomena. Also, as I have mentioned, the outer corona is only visible for a few minutes in each generation; so that, when we attempt to watch the totality of the phenomena from the top of that magnificent radius down to that part of it which cuts the photosphere, there are difficulties of every kind supervening; we can only continuously and effectively study those regions of the atmosphere just above the photosphere, or in other words the phenomena included in the inner corona.

Absorption of the Sun's Atmosphere

But in addition to this there is something else that we can do, though this work is not so valuable, as its results are too general. We can study the general absorptive effect of the whole atmosphere above the photosphere by dealing with ordinary sunlight reflected from a cloud.

The three kinds of absorption which we recognise in spectrum analysis are these. First of all, we have a selective absorption which enables us to determine the presence of the incandescent vapour of any particular metal in the atmosphere of the sun.

Next it was pointed out in the year 1873[1] that the absorption of some elementary and compound gases is limited to the most refrangible part of the spectrum when the gases are rare, and creeps gradually into the visible violet part, and finally to the red end of the spectrum as the pressure is gradually increased. It looks very much as if all the permanent gases, or all gases and vapours at a temperature below that which enables them to give out bright lines or flutings, really possess this kind of absorption, and we know that the absorption of that kind at the sun is enormous, because the blue spectrum of the electric light is very much longer—six or seven or eight times—than the spectrum of the sun, because we get an ultra-violet radiation from the electric light which has been stopped in the atmosphere of the sun. As there are permanent gases in the sun's atmosphere the same conclusion is good for it also. If this absorption both here and at the sun were taken away, it is clear that the sunlight would be much bluer than it is at present. Prof. Langley, of the United States, who seems to be unaware of the results arrived at in 1873, has recently made the same announcement.

There is one other kind of absorption also. We have a general absorption—an absorption working equally upon all parts of the spectrum, which we may call general absorption in its true sense—such absorption, for instance, as we should get by mixing soot with water or smoking a glass and holding it in front of the sun—this would cause a considerable dimming of the light.

We can make this general examination of the atmosphere of the sun by simply observing the spectrum of sunlight reflected from a cloud; but it will be readily understood that, although in that case we shall be able to study the indications of selective absorption and the absorption of the blue end of the spectrum due to such gases as chlorine, and the general absorption of the spectrum due to the existence of solid particles; it will still be an inquiry which will only deal with the matter in its most general aspect, and we shall not be able to localise the exact regions in which these absorptions take place. Further we may say that the result of this study of the absorption of the solar atmosphere taken as a whole is chemical and statical merely. There is nothing dynamical about it. It tells us most important facts concerning the chemical constitution of the sun's atmosphere, taken as a whole, without localising the region in which any particular substance which we find to be absorbing is absorbing; but it does not tell us whether this atmosphere of the sun, which roughly we may accept as about a million of miles high, is in violent movement, or whether it is at rest.

There is, then, very much more to be done before we are fully in presence of the causes of the phenomena to which I have called attention, which stare us in the face every time we look at the sun, either when it is eclipsed, or when it is not.

J. N. LOCKYER

(*To be continued.*)

[1] *Phil. Trans.*, 1873, vol. clxiv. part 2, p. 491.

SCIENTIFIC SERIALS

THE numbers of the *Journal of Botany* for January and February contain no papers of very great importance. Messrs. H. and J. Groves record the addition of two new species to the British Characeæ: *Chara intermedia* and *Nitella capitata*, with figures of both.—Mr. J. G. Baker attempts to trace the relationship between the British and the Continental forms of the difficult genus *Rubus*.—Another addition to the British flora is recorded in *Equisetum littorale*, by Mr. W. H. Beeby.—Most of the other articles relate to descriptive or geographical botany.

THE most important paper in the *Nuovo Giornale Botanico Italiano* for January is an account by Sig. F. Morini of a new disease of cereal crops caused by the attacks of a hitherto undescribed parasitic fungus, *Sphærella exitialis*, allied to *S. graminicola* and *S. Tassiana*.—Sig. Pichi investigates the nature of the reddish-brown spots on the stem of *Bunias Erucago*, which he finds to come under the head of glandular emergences; and Sig. Cavara describes some singular anomalies and monstrosities in the flowers of *Lonicera*.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 14.—"The Coefficient of Viscosity of Air." By Herbert Tomlinson, B.A. Communicated by Prof. G. G. Stokes, P.R.S.

The author employed the torsional vibrations of cylinders and spheres, suspended vertically from a horizontal cylindrical bar, and oscillating in a sufficiently unconfined space. The bar was suspended by a rather fine wire of copper or silver attached to its centre, which, after having been previously subjected to a certain preliminary treatment with a view of reducing the internal molecular friction, was set in vibration.

The coefficient of viscosity of air was obtained from observations of the diminution of the amplitude of vibration, produced by the resistance of the air to the oscillating spheres or cylinders attached to the horizontal bar, arrangements having been made so that the vibration-period of the wire should remain the same, whether the cylinders or spheres were hanging from the bar or not. In deducing the value of the coefficient of viscosity from the logarithmic decrement, the author has availed himself of the mathematical investigations of Prof. G. G. Stokes.[1]

Five sets of experiments were made with hollow cylinders and wooden spheres, in the construction and measurement of which considerable care was taken. When the cylinders were used arrangements were made to eliminate the effect of the friction of the air on their ends. The following are the results:—

Cylinders

Length in centimetres	Diameter in centimetres	Vibration-period in seconds	Temperature of the air in degrees Centigrade	Coefficient of viscosity of the air in C.G.S. units
60·875	2·5636	6·8373	12·02	0·00018171
60·885	0·9636	7·0590	14·63	0·00018122
60·875	2·5636	3·0198	11·69	0·00018024
53·175	2·5636	2·9994	10·64	0·00017845

Spheres

6·364	2·8801	9·35	0·00017820

Maxwell has proved[2] that the coefficient of viscosity of air is independent of the pressure and directly proportional to the absolute temperature. We can, therefore, calculate from the above data what would be the value of the coefficient of viscosity at 0° C.; and when this is done, in the case of each of the five sets of experiments, we obtain the following values:—

Set of experiments	Coefficient of viscosity of air at 0° C.
1st	0·00017404
2nd	0·00017201
3rd	0·00017284
4th	0·00017359
5th	0·00017230

The mean of these numbers is 0·00017296 with a probable

[1] See Prof. Stokes's paper "On the Effect of the Internal Friction of Fluids on the Motion of Pendulums," *Trans.* Camb. Phil. Soc., vol. ix. Part II., 1850.

[2] *Phil. Trans.*, 1866, vol. clvi. Part I.

error of only 0·14 per cent. The formula for finding μ_t, the coefficient of viscosity of air at the temperature $t°$ C., is therefore—

$$\mu_t = 0{\cdot}00017296\left(1 + \frac{t}{273}\right).$$

The value of the coefficient of viscosity of air at 0° C., given above, though much nearer to that obtained by Maxwell than any which has been got by other observers, nevertheless differs from it by more than 8 per cent.[1]

January 28.—"On Local Magnetic Disturbance in Islands situated far from a Continent." By Staff-Commander E. W. Creak, R.N., F.R.S.

It has long been known that local magnetic disturbance has been found to exist to a considerable extent at St. Helena, Bermuda, and other islands. Observers in the islands adjacent to the west coast of Scotland have also found local disturbance existing in them, and, in order to determine its amount, have obtained normal values from curves of the magnetic elements calculated from neighbouring regions where observations have been made apparently free from magnetic disturbance.

In the case of islands situated far from a continent, however, normal values of the three magnetic elements may be obtained by the method of turning the ship in azimuth and observing on eight or more equidistant points of the compass in the process called "swinging," whereby the effects of the horizontal disturbing forces proceeding from the iron of the ship may be eliminated, and by occasional observations at well-selected land stations known to be free from local magnetic disturbance, the values of the vertical magnetic forces caused by iron in the ship may also be ascertained for all latitudes, and the necessary corrections applied to the observations.

A series of magnetic observations have been made on land in Bermuda, Madeira, Teneriffe, St. Vincent (Cape de Verde), St. Paul Rocks, and Sandwich Islands in the northern hemisphere and Tristan d'Acunha, Ascension, St. Helena, Kerguelen Island, New Zealand, and Juan Fernandez, in the southern hemisphere. The observations made in these several islands have been collected for this paper and compared with the normal values as observed at sea in their neighbourhood.

Throughout the discussion the term "blue" magnetism has been adopted to indicate that kind of magnetism which attracts the marked or north-seeking end of the needle, and "red" for that which repels it.

At Bermuda the most extensive series of observations has been made, and a strong focus of blue magnetism found to exist between Mount Langton and the lighthouse on Gibbs Hill.

The position of this focus was approximately defined by drawing, on a map of the western portion of Bermuda, lines of equal values of the disturbance from the normal for each element, and it was found that at one position eastward of this focus the westerly declination was increased 2° 39′, and at another, westward of it, diminished by 3° 5′. The disturbance of the inclination and vertical force gradually increases as the focus is approached, amounting in the inclination from +0° 11′ to 1° 47′, and in the vertical force from zero to +·314 (British units).

Bermuda may be taken as an example of the results generally found in the other islands under discussion, for the observations show that, north of the magnetic equator, the north point of the compass is invariably attracted inland towards some part of the island, and south of the magnetic equator it is repelled, showing marked divergence of results between observations made on the east and west coasts. The inclination and vertical force are, with rare exceptions, increased in the islands on both sides of the magnetic equator.

On the whole the local disturbances are not very large, but it may be remarked that they render the comparison of observations at different epochs very doubtful in value, unless the precise position of observation be rigidly adhered to.

Before dismissing the question of the actual observation, the results obtained at the Bluff, Bluff Harbour, New Zealand, are worthy of note—

		°	′	
Declination observed	On the summit of the Bluff ...	6	54	E.
	30 feet north ,, ...	9	36	W.
	,, west ,, ...	5	4	E.
	,, east ,, ...	46	44	E.
Normal from sea observations		16	20	E.

On the summit of the Bluff there was thus shown to be a strong focus of red magnetism.

The general results tend to show that the magnetic disturbance in islands north of the magnetic equator is due to an excess of blue magnetism, and in those south of it to an excess of red magnetism compared with that due to the respective positions of the islands on the earth considered as a magnet.

In Sir G. Airy's treatise on magnetism, reasons have been given for believing that the magnetism of the earth is not due to sources external to it, nor specially existing on its surface, but that the source of its magnetism lies deep.

With these reasons in view, and the results obtained from the observations discussed, the possible conclusion is drawn that the excess of "blue" and "red" magnetism observed in the islands above-mentioned proceeds from portions of those islands which have been raised to the earth's surface from the magnetised part of the earth, forming the source of its magnetism.

For the numerical data upon which the preceding remarks have been founded, and descriptive map of the Bermuda magnetic disturbances, reference should be made to the original paper.

Linnean Society, February 4.—Sir John Lubbock, Bart., President, in the chair.—Mr. J. Dallas, of the Exeter Museum, exhibited a specimen of the somewhat rare glossy ibis (*Plegadis falcinellus*, L.), obtained from Mr. J. H. Clyde, of Bradsworthy Vicarage, Holsworthy, Devon, in whose possession it had been since killed in that neighbourhood, September 1851.—Mr. F. J. Hanbury showed a series of forms of the genera Hieracium and Carex gathered by him in Caithness and Sutherlandshire, all new to Britain, but representative of the Scandinavian flora.—Mr. C. Bartlett showed a remarkable African (?) caterpillar, 7 inches long, of a steel-gray colour, and abundantly hairy and spiny.—Mr. W. H. Beeby drew attention to an example of *Equisetum littorale* got by him on Bisley Common, Surrey, and hitherto not known as an English plant.—Mr. J. C. Sawer exhibited a sample of a superior sort of the essential oil of lavender and a spike of the plant, a cross-breed of varieties introduced by him from the Continent, and grown at Brighton.—Mr. A. Hammond showed a microscopic section of the integument of the larva of a dipterous insect (*Stratiomys chamæleon*), raising the question as to whether the polygonal areas of the cuticle, described by M. Villiane , were surface-markings only, or, as he held, cellular in character.—Mr. F. Darwin read a paper on the relation between the bloom of leaves and the distribution of the stomata. "Bloom" on leaves is used by him to mean a coating of minute particles of a waxy character, which is removable by hot water or ether. But gradations occur from a distinct and appreciable greasiness throwing off moisture to such as are easily wetted. A large series of leaves of different groups of plants have been studied by him, and for convenience in the analysis of data he has divided them into four classes. Leaves of Class I. are devoid of bloom on both surfaces, and yield 54 per cent. which have *no* stomata on the upper surface. In Class II. bloom is deficient above but present below, whereof 83 per cent. contain stomata on the leaves' lower surface. Class III. possesses bloom on the leaves above, but none inferiorly, and 100 per cent. of these have stomata on the upper surface. Class IV. have leaves with bloom on both surfaces, 62 per cent. of them having stomata above. From such analyses and other facts and data given, Mr. Darwin concludes that the accumulation of stomata accompanies that of bloom, and, other things being equal, that it is functionally protective against undue wetting by rain, and thus injury to the leaf-tissue.—In a communication by Mr. E. C. Bousfield, on the Annelids Slavina and Ophidonais, he criticises Herr Vejdovsky's new genus *Slavina*, and objects to his identification of *Nais appendiculata* and *N. lurida*, while giving a full description of the latter, and observing points of contrast. He also describes touch organs in Ophidonais, similar to those of Clavina, mentioning other points of similarity between the two. He further proposes to do away with the former genus, including its only species under Slavina.—Brigade-Surgeon E. Bonavio, in a paper afterwards read, asserts that the wild *Citrus hystrix*, D.C., is the grandparent of *Lima tuberosus*, *L. agrestris*, *Limonis feri*, *Limonellus aurarius*, and others, while also more distantly the grandparent of the cultivated true limes of India, Ceylon, &c. The reason why the lime has so persistently a winged petiole, according to him, is that this is derivative from the immense winged petiole of its progenitor *Citrus hystrix*.—Prof. Richard J. Anderson communicated a paper on the relative lengths of

[1] Prof. Stokes, in a note at the end of the paper, has shown that a very small deviation from horizontality of the movable disks used by Maxwell would make the value of the coefficient obtained by him 8 per cent. too great.

the segments of limbs in the chick during development between the sixth and twentieth days. On or even before the ninth day, the bones of the fore-arm and manus are longer than the corresponding segments of the leg and foot. Afterwards the tarso-metatarsus begins to lengthen, and maintains a greater relative size at the end of incubation.

Zoological Society, February 16.—Dr. St. George Mivart, F.R.S., Vice-President, in the chair.—Mr. Sclater exhibited a specimen of the new Paradise-bird, *Paradisornis rudolphi* of Finsch and Meyer, lately discovered by Mr. Hunstein in the Owen Stanley Mountains of New Guinea, and pointed out the characters in which it differs from typical *Paradisea*.—The Secretary exhibited, on behalf of Mr. Taczanowski, C.M.Z.S., the skin of an owl from the south-east of the Ussuri country, on the frontiers of Corea, which appeared to be referable to *Bubo blakistoni* of Seebohm.—Mr. E. Gerrard, Jun., exhibited heads and skulls of two African rhinoceroses (*R. bicornis* and *R. simus*), obtained by Mr. Selous in Mashuna-land.—Prof. Ray Lankester exhibited and made remarks on a drawing of a restoration of *Archæopteryx*.—Mr. Oldfield Thomas gave an account of a striking instance of cranial variation due to age, as shown in two specimens of the skull of the Canadian marten (*Mustela pennanti*), which presented extreme differences in the breadth of the zygomata, in the contraction of the interorbital space, and in the development of the occipital crest. Special stress was laid on the fact that such changes as these take place after the animal has attained maturity.—Mr. W. L. Sclater exhibited and described a new Madreporarian coral, which he proposed to call *Stephanotrochus moseleyanus*. The coral had been dredged in the Faroe Channel during the cruise of H.M.S. *Triton* in the summer of 1882. Some account of its anatomy and histology was also given.

Chemical Society, February 4.—Dr. Hugo Müller, F.R.S., President, in the chair.—The following note was read:—The chemical formula for wool keratine, by Edmund J. Mills, F.R.S.—A lecture was delivered on methods of bacteriological research from a biologist's point of view, by Dr. Klein, F.R.S. The object of the lecture was to bring before the Chemical Society the methods used at present by pathologists in the investigations of micro-organisms associated with disease. These methods, thanks to the investigations of Koch, are greatly in advance of those hitherto employed by chemists in the investigation of the activity of bacteria. The enormous amount of work that has been done by chemists since the memorable investigations of Pasteur on fermentation and putrefaction, if viewed in the light of modern bacteriological methods, is in a great measure unsatisfactory and imperfect, more so than will be conceded by chemists. This unsatisfactory state is chiefly due to the imperfect methods employed. Specific chemical action is ascribed to certain organisms, because these were found present in the substances examined, no regard being paid as to whether these organisms were alone active or whether they were only concomitant and dependent on the activity of others. Numbers of instances can be adduced to prove this: amongst them may be mentioned the assertions that alcoholic fermentation is produced by *Mucor racemosus*, and also by a bacillus besides saccharomyces; that the ammoniacal fermentation of urine is due to a bacillus; that the lactic acid fermentation is due to a micrococcus and also to a bacillus. To determine whether a definite chemical process is produced by a definite organism, and which, it is necessary to prove (1) that the substances to be acted upon are at the outset free of any accidental organisms; (2) that the particular organism to which the definite chemical activity is ascribed is the only one concerned in this process. The methods used must fulfil these elementary conditions, that is to say: (1) the materials used must be sterile at the outset, and protected from accidental contamination; (2) the specific organism must be obtained in pure cultivations, and this purified organism must be capable of producing the specific chemical change. Viewed in this light, few of the assertions hitherto made bear criticism. As one of the most striking instances it may be mentioned that, notwithstanding the enormous amount of knowledge gained by chemical research into the changes of proteid bodies during putrefaction, there is no reliable answer yet given to the questions—Which organism or organisms are concerned in this complex process? Which part of the process is due to which organism? Is the analytical process by which proteids are carried down to relatively simple nitrogenous principles done by one or more organisms and by which? Is the production of the alkaloids known as ptomaines due to the same organism or organisms which started the process of putrefaction? Another equally important series of investigations refers to the process of nitrification; here also no definite answer can be given. So also the chemical changes due to the growth of moulds are waiting for investigation. When chemical research begins to adopt such methods as are employed by pathologists, but not till then, its results will be unequivocal. The methods used for sterilising materials, for studying and recognising the morphological characters of organisms, for obtaining pure cultivations, and for inoculating nutritive materials with them were then minutely described.

Physical Society, February 13.—Annual General Meeting. Prof. F. Guthrie, President, in the chair.—Prof. T. H. Huxley and Mr. A. E. Mills were elected Members of the Society.—The President read the report of the Council. The Treasurer, Dr. E. Atkinson, presented his report, which was adopted. The meeting resolved that votes of thanks be accorded to the Committee of the Council of Education, the President and Officers of the Society, and the Auditors of the Society's accounts. The meeting then proceeded to elect officers for the forthcoming year, and a ballot having been taken, the following were declared elected:—President: Dr. Balfour Stewart, F.R.S.; Vice-Presidents: Dr. J. H. Gladstone, F.R.S., Prof. G. C. Foster, F.R.S., Prof. W. G. Adams, F.R.S., Sir W. Thomson, F.R.S., Prof. R. B. Clifton, F.R.S., Prof. F. Guthrie, F.R.S. (the above have filled the office of President), Prof. W. E. Ayrton, F.R.S., Shelford Bidwell, M.A., Prof. H. McLeod, F.R.S., Prof. W. Chandler Roberts-Austen, F.R.S.; Secretaries: Prof. A. W. Reinold, F.R.S., and Walter Baily, M.A.; Treasurer: Dr. E. Atkinson; Demonstrator: C. Vernon Boys; other Members of Council: Conrad W. Cooke, Prof. G. Forbes, F.R.S.E., Prof. F. Fuller, R. T. Glazebrook, F.R.S., Dr. J. Hopkinson, F.R.S., Prof. J. Perry, F.R.S., Prof. J. H. Poynting, Prof. A. W. Rücker, F.R.S., Prof. S. P. Thompson, Dr. C. R. Alder Wright, F.R.S.—Prof. Guthrie, in resigning the position of President, thanked his colleagues for the help they had afforded him since he became President of the Society in 1884; he also congratulated the Society upon the highly satisfactory state to which it had attained.—The meeting then resolved itself into an ordinary meeting. In the absence of the President, Prof. Balfour Stewart, the chair was occupied by Prof. G. C. Foster.—The following communications were read:—On experimental error in calorimetrical work, and on delicate calorimetrical thermometers, by Prof. U. S. Pickering. In conducting a great number of determinations of the heat of dissolution of a solid body in water, the author has had an opportunity of detecting the sources of error incident on such work, and by an examination of the results has not only obtained the mean error of a series of observations, but has been able to apportionate this error to its various causes. In the experimental work it was found that the presence of anything but air between the calorimeter and jacket was most injurious; the space should be entirely open, and no cover of any sort should be used. Before reading the thermometers, as pointed out by Berthelot, the top of the stem should be tapped for some time, otherwise the mercury lags behind the true temperature; but besides this thermometric error, which the author calls the "temporary error," is another effect which may be termed the permanent error, of a similar kind, which no amount of tapping will remove. He has found and verified by special experiments that a thermometer when rising is invariably too low, while when falling it is invariably too high. Error due to this, which varies in amount with different instruments, is avoided by conducting the whole experiment with a rising or with a falling thermometer. The thermometers employed in these experiments had a range of 15° C., and a total length of 600 mm. The experiments were performed at temperatures varying from $-1°$ to 26° C., and as it was important that the same thermometer should be used in different experiments, and even advisable to use the same part of the scale of the thermometer, the following expedient was devised: The thermometer was first heated to the highest temperature required in the experiment, and, by the application of a flame to the mercurial column just below the enlarged space at the end of the tube, that part of the mercury above the flame was broken off and driven into the space, where it remained when the thermometer was cooled. By this means the relative value of a scale division was only inappreciably affected, while the absolute value could be obtained from a single comparison with a standard. From an examination of the results obtained, the

author concludes that for further accuracy in this kind of work we must look for improvements in the methods employed, the instruments having, he believes, attained to a state as near perfection as possible.—On some new forms of calorimeters, by Prof. W. F. Barrett. These instruments were constructed for the accurate and ready determinations of specific heats, notably those of liquids. In the first form the bulb of a thermometer is blown into the form of a cup of about 4 cubic centimetres capacity, which thus acts as a calorimeter. Into this cup the liquid is dropped directly from a burette, its temperature being observed by a thermometer in the burette, the mouth of which is closed by the end of the bulb of the thermometer, which is ground, and thus acts the part of a stopper, so that, on raising the thermometer, the liquid flows from the burette into the cup. The thermometer itself forms a balance, the horizontal stem acting as the beam is supported by a knife-edge, and a pan is attached to the further end by the addition of weights to which the weight of liquid added can be ascertained. In the second form a simple thermometer with a large bulb is used, the latter dipping into a silver vessel, into which the liquid is introduced as before.—Prof. S. P. Thompson exhibited a glass calorimeter, similar in construction to that of Favre and Silbermann; water is used instead of mercury, the great density of which renders it unsuitable for use in so large a glass vessel.

Anthropological Institute, February 9.—Mr. Francis Galton, F.R.S., President, in the chair.—The election of Prof. Otio T. Mason, Prof. J. Ranke, Dr. G. Manouvrier, and Prof. J. Kollmann as Honorary Members, and of the Rev. W. Birks, J. G. Blumer, F. H. Collins, J. Spielman, and T. L. Wall, as Ordinary Members, was announced.—The President read a paper on recent designs for anthropometric instruments, and called particular attention to a number of instruments made by the Cambridge Scientific Instrument Company, and exhibited by Mr. Horace Darwin, who afterwards described them and showed the manner in which they are used.—M. Collin, of Paris, exhibited a traveller's box of anthropometric instruments and Topinard's craniophore.—Prof. A. Macalister read a paper on a skull from an ancient burying-ground in Kamchatka; and Dr. G. Garson read a paper on the cephalic index, in which he proposed a system of nomenclature for international adoption which has already been accepted in principle by several of the leading anthropologists on the Continent.

Royal Meteorological Society, February 17.—Mr. W. Ellis, F.R.A.S., President, in the chair.—Mr. G. Buchanan, Capt. G. H. Leggett, Dr. H. C. Taylor, J.P., and Mr. J. Tolson were elected Fellows of the Society.—The following papers were read:—General remarks on the naming of clouds, by Capt. H. Toynbee, F.R.Met.Soc. The author considers it important to keep to Luke Howard's nomenclature, leaving it to the observers to express by an additional word any peculiarity they notice in a particular cloud.—On the thickness of shower-clouds, by Mr. A. W. Clayden, M.A., F.G.S. From some measurements made by the author during the summer of 1885 he has come to the conclusion that clouds of less than 2000 feet in thickness are not often accompanied by rain; and, if they are, it is only very gentle, consisting of minute drops. With a thickness of between 2000 and 4000 feet the size of the drops is moderate. As the thickness gets greater, the size of the drops increases, and at the same time their temperature becomes lower, until, when the thickness is upwards of 6000 feet, hail is produced.—On the formation of rain, hail, and snow, by Mr. A. W. Clayden, M.A., F.G.S. The author points out that all observations tend to show that, except under quite abnormal conditions, the temperature of the atmosphere falls as the height above sea-level increases; and there seems no reason whatever for assuming that the law does not apply to that portion of the atmosphere which forms a cloud. Hence, if a drop were to be formed at or near the upper surface of a cloud, it would fall down into a region saturated with vapour at a temperature above its own. The result will be further condensation, producing a larger drop; and this process will continue until it leaves the cloud. If its temperature is below the dew-point of the air it falls through, condensation will continue until it reaches the ground. However, it is obvious that this subsequent gain cannot bear any very large proportion to the growth while falling through the saturated cloud, from which the conclusion follows that the size of the drop must increase with the thickness of the cloud. The author suggests that condensation begins on the upper surface of the cloud by the cooling of some of the liquid cloud-particles. If this particle is cold enough it will solidify, and snow will be formed. Should it not be quite cold enough to solidify at once, owing to its minuteness, but remain still below the freezing-point, hail is formed. Finally, if the temperature is not low enough for either snow or hail, rain is produced.—On three years' work by the "chrono-barometer" and "chrono-thermometer," 1882–84, by Mr. W. F. Stanley, F.R.Met.Soc. The chrono-barometer is a clock that counts the oscillations of a pendulum formed by a suspended barometer. The upper chamber of the pendulum is a cylinder of an inch or more in diameter. By change of atmospheric pressure the mercury in the pendulum is displaced from the bottom to the top, and *vice versâ*. The rate of the clock is accelerated or retarded in proportion to the displacement of the mercury. The chrono-thermometer is a similar clock to the above, and the pendulum is also a barometer; but instead of the lower chamber being exposed to pressure, the whole tube is inclosed in a second hermetically-sealed tube containing air. Atmospheric pressure being thus removed, the expansion of the included air by heat alone forces the mercury up into the vacuum-chamber, and alters the period of oscillation of the pendulum.

Victoria (Philosophical) Institute, February 15.—A paper on final cause, by Prof. Dabney, of Texas University, was read.

EDINBURGH

Mathematical Society, February 12.—Dr. R. M. Ferguson, President, in the chair.—Mr. William Harvey communicated several theorems in kinematics with geometrical demonstrations; and Mr. R. E. Allardice submitted a proof, by Mr. T. Hugh Miller, of Lagrange's theorem.

PARIS

Academy of Sciences, February 15.—M. Jurien de la Gravière, President, in the chair.—Discourses pronounced at the obsequies of M. Jamin, by M. J. Bertrand on behalf of the Academy, and by M. L. Troost in the name of the Faculty of Sciences.—Remarks on the 172 tornadoes recorded in the United States during the year 1884, by M. Faye. From the scientific point of view the author considers that it seems definitely established that there is a definite portion of an area of low pressure within which the conditions for the development of tornadoes is most favourable. The special tornado reporters for the Signal Service are now endeavouring still more accurately to determine this "dangerous octant," as it is called in America. February 19, 1884, is mentioned as memorable in the history of these destructive phenomena. On that day no less than forty-five were recorded in the South-Eastern States, attended with a total loss of 800 lives, 2500 injured, 10,000 houses and buildings destroyed, and from 10,000 to 15,000 people left homeless. —Note on a prophylactic means of protecting the vine by destroying the winter egg of Phylloxera, by M. P. de Lafitte. This plan has now been tried with considerable success during the last three years at three different places in the department of Lot-et-Garonne. The State aid granted for the purpose having long been exhausted, growers have been encouraged by these results to continue the experiments at their own expense.—On the periods of the double integrals, by M. E. Picard.—On the theory of reciprocants, by M. R. Perrin. It is shown that the new forms introduced by Prof. Sylvester into mathematical analysis may be considerably simplified by the employment of a few general theorems here communicated to the Academy.—Note on the polhodie and terpolhodie (continued), by M. A. Mannheim.—Spectroscopic observations on the new star discovered by Mr. Gore in Orion, made at the Nice Observatory by MM. Perrotin and Thollon. This star presents a fine line spectrum stretching far into the violet, the red and especially the green being remarkably brilliant, while the yellow appears relatively dull. This suggested a certain analogy with the spectra of comets, only much more complicated, and the idea was confirmed by subsequent comparative observations made on α Orionis, which shows a characteristic continuous spectrum intersected by dark bands and lines. Notwithstanding the faint yellow bands, the new star would therefore appear to be of the same type as α Orionis.—Note on the deviation of the equipotential lines, and the variation of resistance shown by bismuth in a magnetic field, by M. Leduc.—On the electrolysis of the salts: influence of temperature, of the distance and surface of the electrodes, by M. Adolphe Renard.—Observations in connection with M. A. Millot's note on the "Products of Oxidation of Carbon by the Electrolysis of a Solution of Ammonia," by

MM. A. Bartoli and G. Papasogli. To M. Millot's statement that he failed to find mellic acid and its derivatives in the electrolysed ammoniacal solution, it is pointed out that the failure was doubtless due to the fact that his experiments were not conducted under the same conditions as those of the authors. —Note on a combination of acetic ether and chloride of magnesium, by M. J. Allain le Canu.—On the influence of the acid oxalate of ammonia on the solubility of neutral oxalate, by M. R. Engel.—On the γ-bromo and iodobutyric acids, $XCH_2—(CH_2)_2—CO(OH)$, by M. Louis Henry.—Note on the affinities of the Eocene floras of the West of France with those of North America, by M. Louis Crié. The attention of geologists and botanists is here directed to certain fossil plants occurring in the Eocene sandstones of West France, which present evident affinities to several species of the lignitic group described and figured by M. Leo Lesquereux in his "Contributions to the Fossil Flora of the Western Territories" (Washington, 1878). *Pteris Fyeensis*, Crié, *Lygodium Fyeense*, Crié, *Lygodium Kaulfussii*, Heer, *Asplenium Cenomanense*, Crié, and others are compared respectively with *Pteris pseudopennæformis*, Lesq., *Lygodium Dentoni*, Lesq., *Lygodium neuropteroides*, Lesq., *Gymnogramma Haydenii*, Lesq., &c.—Note on the subject of atmospheric disturbances—M. Faye's theory of whirlwinds, by M. Jean Luvini. It is shown that the slight convergence of the current towards the centre of great cyclones, as appears determined by observation, would be more opposed to the theory of absorption than to M. Faye's gyratory theory. A slight convergence near the ground is in fact a natural consequence of the principles regulating the movement of fluids.

BERLIN

Physiological Society, December 11, 1885.—Dr. Gad spoke of an apparatus executed by him and set up in the demonstrating-room, designed to show the play of the valves of the heart. A short canula of 7 cm. in diameter was tightly fixed into the left auricle of a large bullock's heart, and the free end was closed in a water-tight manner by a plate of looking-glass. At the side of the canula was a short tube connected by an elastic tube with an upright bottle. A similar canula of 3 cm. in diameter was fastened into the aorta close over the semi-lunar valves, and its lateral tube conducted by an elastic pipe into a funnel through which the water flowing from the ventricle reached the bottle. A third canula was fastened into the apex of the heart, and connected with a thick-walled elastic ball, by the compressions and elastic expansions of which the vigorous operations of pressure and expansion required for the circulation of the water filling the apparatus were achieved. In the ventricle was placed a small Edison lamp, the conducting wires to which were, by means of a water-tight tube at the side of the third canula, directed outwards. When the elastic ball was rhythmically compressed, then the alternating play of the cardiac valves was seen through the two first canulæ, and, by means of a suitable mirror before the canulæ, might be exhibited to a large class.—Dr. Goldscheider reported on the results of an investigation into the nerve-endings at the pressure and temperature points, the existence of which he had demonstrated. In the expectation that specific terminal organs of the cutaneous nerves must, if they existed, be met with at the pressure points and points of cold and warmth, Dr. Goldscheider had cut out of his forearm, at the isolated pressure points and temperature points, small wedges of skin, and prepared them with arsenic acid and auric chloride, embedding in paraffin. Of the preparations he made a series of sections which in most cases showed longitudinal sections through the cutaneous nerves. The microscopical examination revealed that no Paccinian or Meissner corpuscles were situated either at the pressure or at the temperature points. On the contrary, the speaker found regularly at the pressure points, which he had previously marked by the prick of a needle, a bundle of medullated nerve-threads approaching close to the boundary of the corium. At this point the bundle split into two branches proceeding in opposite directions, and then further ramifying. These two divisions made their way mostly between the corium and epidermis, and but seldom penetrated as far as the second layer of the epidermis cells. So far as ends of the nerves were visible, they were situated between the cells and were pointed. On the temperature points a bundle of nerve-fibres were likewise seen to rise, but in this latter case they ended in a pretty narrow net of very fine, non-medullated threads, and never reached the epidermis. In the neighbourhood of the nets of the temperature nerves blood-capillaries were regularly met with. Dr. Goldscheider was of opinion that the cutaneous nerves possessed no specific terminal organs, but simply merged into narrower or wider nets, and that the sensitive points for pressure and temperature were situated at the spot where the terminal division of the nerve-bundles occurred.—Dr. Benda supplemented the address he delivered at the last meeting on spermatogenesis by hypothetical considerations regarding the significance of the microscopical figures found by him.

January 15.—Dr. Müllenhoff spoke of his observations respecting the structure of bee-cells. Producing specimens of combs and models, he handled the geometrical figure of the cells, the fact of which had been recognised so far back as the time of the Greek philosopher Pappus, and the measure of which had been taken by Réaumur, the cells forming a hexagonal column bounded on the side turned to the partition wall by a trilateral pyramid, on the other by a plain terminal surface. To account for the great regularity of the cells, Buffon had propounded that they originated in the mutual pressure of the wax-vesicles, and put this explanation to the proof by an experiment in which he filled up a vessel with peas, and stuffed the interstices with water, which caused the peas to swell. In point of fact the round bodies got thereby converted into precisely geometrical figures with trilateral terminal surfaces. They were, however, no hexagonal columns, but regular rhombendodecahedrons. Dr. Müllenhoff had now, by a long series of observations in beehives, studied the structure of the bee-cells, and had established that the bees, which, as was known, worked closely compacted together, first stuck a little thick wax disk to the wall, and then gnawed away at it till the plate had grown so thin that under the all-sided pressure, in accordance with the law respecting equilibrium figures of fluid membranes discovered by Plateau, they assumed the form of a half rhombendodecahedron with trilaterally pyramidal surfaces. The bees then proceeded to build on the six free edges by attaching to them small wax plates, and gnawing away at them till they had grown so thin that under the pressure of the neighbouring cells they took on the form of a hexagonal column. The column was made so long that the queen bee, in laying her eggs, rested with her posterior body on the floor of the cell, and, with her anterior legs, was able to take hold of the free edge of the column. The geometrically-regular figure of the bee-cells was accordingly conditioned by physical laws, and not by any knowledge inherent in the bees of geometrical laws in respect of the greatest economy of space and material. That without the co-operation of the Plateau laws the bees were able to achieve no regular cells was demonstrated by the queen-cells, which, constructed isolatedly, had the irregular form of a thimble.—Prof. du Bois-Reymond gave a short summary view of the investigations he had carried out in the past summer into living torpedoes, by means of which he had pretty well solved all the problems which were at all capable of being submitted to experimental test on the animals of the aquaria, which were very much reduced in strength and exhausted by inanition. Having first ascertained the direction of the cuticular current, he examined the polarisation-phenomena yielded by stripes of the electrical organ under the influence of foreign currents. He learned that homodromous currents, *i.e.* such as were directed in the same way as the direction of the shock, gave always a homodromous polarisation, while heterodromous currents never produced heterodromous polarisation, and only occasionally homodromous polarisation. This fact was capable of explanation by assuming that what appeared as homodromous polarisation was but a shock of the fish caused by the foreign current, a shock which of course could only be homodromous; or that the electrically polar molecules directed by the foreign polarising current were capable of being turned only in one direction. A decision between these two explanations could not be arrived at. Prof. du Bois-Reymond next examined the conductivity of the electrical organ, and ascertained that it conducted homodromous currents almost as well as did the muscle, but that it conducted heterodromous currents much worse, so that the electrical organ was almost half an insulator for heterodromous currents. The conduction power of the electrical organ of the torpedo was consequently irreciprocal. This irreciprocity of conduction obtained only for strong currents and for those of short duration. It was met with, moreover, only in the living organ. The defunct organ conducted considerably better than the living, and was equally good for the conduction of homodromous and heterodromous currents. The irreciprocity, finally, increased with the

length of the organ stripe. This irreciprocity of conduction explained in a most highly interesting manner the powerful effect of the strokes directed outwards of electrical fish. Let us suppose a column of the electrical organ reaching from the back to the belly, then would the electrical currents of the organ diffuse themselves at the positive pole surface of the back, and in accordance with well-known laws respecting the distribution of electrical currents in an endless conductor, betake themselves to the negative pole surface of the belly. Were the organ a good conductor of its currents, then would the most intense threads of currents balance themselves in the organ, and only very faint ramifications of current penetrate into the water. These currents, however, had a heterodromous direction in the organ, and were therefore ill-conducted. The most intense threads of current were forced therefore to penetrate into the water, and were accordingly able to produce vigorous effects outwardly. The speaker had finally examined a phenomenon in the powerful electric nerves of the torpedo, which he had earlier had occasion to observe in other nerves. If a piece of nerve were cut off and the electromotory energy of the two transverse sections determined, then did the electric nerves show that the peripherical cross-section acted in an electromotory sense more powerfully than did the central. If both cross-sections were derived, then was an ascending current received in consequence thereof. This occurred with such regularity that the peripheral and the central nerve could be recognised on any piece whatsoever by the direction of the axial nerve current, which was opposed to the direction of the physiological action. In the sensory nerves Prof. du Bois-Reymond had found a reverse axial current directed from the centre to the periphery. He had the phenomenon then further investigated by Dr. Mendelssohn, and it was quite generally established that centripetal active nerves, such as the nerves of the senses and the posterior roots of the spinal nerves, always showed a descending axial nerve current, whereas centrifugal active nerves, such as the motory and the electric nerves, possessed an ascending axial nerve current. In the case of mixed nerves an axial nerve current could not be decidedly demonstrated.

Meteorological Society, January 12.—Dr. Hellmann laid before the Society in the form of a table, the results of the rain registration at the eleven stations to the west of Berlin for the six months from July to December, and drew attention to the fact that in the winter months the values yielded by the different rain-gauges coincided very closely, whereas in summer differences reaching as much as 50 per cent. occurred.—Herr Opel spoke of the quantities of water discharged by rivers, and in particular by the Elbe. In view of the great difference prevailing in the registrations of the amounts discharged at high water, it deserved to be noted as an indication of important progress that Herr Sasse, on the basis of a careful special investigation of the subject, had formulated the proposition that the curve of the quantities of water discharged formed a parabola to the high-water marks as abscissæ, but that the zero-point of the parabola lay deeper than the zero-point of the water-mark. From a long series of examples the author demonstrated the correctness of the formula, and directed attention to several singularities in the quantities of water discharged by the Elbe at various stations of its course through Germany, singularities which, while in part explicable by the tributaries, demanded further investigation. The speaker then discussed the question of the volumes of water in rivers, on which in quite recent times several scientific investigators had expressed an opinion to the effect that they had diminished in comparison with the volumes of water in the rivers last century. This diminution of volume was in large part attributed to the progress of the denudation of forests in the river districts. Herr Opel was, however, of opinion that these registrations of the rivers were rather related to the present well-ascertained lower state of the rivers at low water. Since at many places the beds of the rivers had, altogether irrespective of their profile, been enormously narrowed, the rivers at high water had, in consequence, dug themselves out a deeper channel, and in this way depressed the mass of waters. Rain returns did not, at all events, testify to any diminution in recent times in the supply of water. The observations on the amounts discharged by the rivers of Prussia have hitherto rested on very unsatisfactory bases. At a number of stations daily observations of water-marks were made. The average of these was then taken, and the monthly and yearly averages of these water-marks were used as a basis for the calculation of the monthly and yearly discharges. Seeing, however, that the amount of water discharged represented a parabola, it was impossible to calculate it from the height of the state of the water alone. The amounts of water corresponding with the average water-marks deviated, as was shown in a number of instances, very considerably from the average of the water volumes corresponding with the several high-water marks. Another source of error lay in the circumstance that the observations of water-marks were made only once a day, from which observations the monthly and yearly averages were deduced. In view, however, of the repeated and often important variations in the states of the water, once-a-day observations were really of little value. Hourly observations even would not suffice. What is required are self-registering gauges of the states of the water, as being the only means whereby to obtain trustworthy values for the amount of the river-discharges. Over and above this, in the case of the larger rivers, measurements of their respective quantities at low, mean, and high water should, every few years, be very carefully made and the parabola determined, from which the quantities discharged could then be calculated from the registered high-water marks with some degree of certainty.

BOOKS AND PAMPHLETS RECEIVED

"Class-Book of Geology": Dr. A. Geikie (Macmillan and Co.).—"Trigonometry for Beginners": Rev. J. B. Lock (Macmillan and Co.).—"Fourth Annual Report of the Board of Control of the New York Agricultural Experiment Station for the Year 1885" (Andrews, Rochester).—"The Co-operative Index to Periodicals," vol. i. No. 4 (New York).—"Hints for Land Transfer and a State Land-Bank": Nemo.—"Revista di Artiglieria e Genio," vol. i. (Roma).—"The Star-Guide": Latimer Clark and Herbert Sadler (Macmillan and Co.(.—"The Artist's Manual of Pigments": H. C. Standage (Lockwood and Co.).—"Observaciones Magnéticas y Meteorológicas del Real Colegio de Belen de la Compania de Jesus," January to March, April to June, 1885 (El Iris, Habana).—"Scientific Results of the Second Yarkand Mission—Aranelida": Rev. O. P. Cambridge (Government Printing-Office, Calcutta).—"The Comparative Anatomy of the Pyramid Tract": E. C. Spitzka (Jenkins, New York).—"Science for Nobleness, for Knowledge, and for Use": Sir H. W. Acland (K. Paul and Co.).

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